

PINNOTHERIDS (CRUSTACEA: DECAPODA) AND
LEPTONACEANS (MOLLUSCA: BIVALVIA)
ASSOCIATED WITH SIPUNCULAN WORMS
IN HONG KONG

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Abstract.—The intertidal soft-bottom sipunculans *Sipunculus nudus* Linnaeus and *Siphonosoma cumanense* (Keferstein) in Hong Kong each have a pair of commensal associates, one leptonacean bivalve and one pinnotherid crab, inhabiting their burrows. With the former are the bivalve *Fronsella ohshimai* Habe and members of a new genus and species of pinnotherid crab, *Indopinnixa sipunculana*, and with the latter are the bivalve *Nipponomysella subtruncata* (Yokoyama) and the crab *Mortensenella forceps* Rathbun. The bivalves occur in mean numbers of 5 (range 1-9) and 3.3 (range 1-7)/host, respectively, and the crabs either singly or in pairs. The pairs of associates seem mutually exclusive of each other, with regard to both inter- and intra-host specificity.

Two sipunculans, *Sipunculus nudus* Linnaeus and *Siphonosoma cumanense* (Keferstein), build deep burrows on Hong Kong's soft, muddy shores. Over the course of a number of field trips by one of us (B.M.) to such a sipunculan habitat at Tai Tam Bay on the south coast of Hong Kong Island [22°15'N, 114°11'E], a number of specimens of each of these species has been collected, and two species of commensals have been found in association with each of them. Morton and Morton (1983:204) listed the leptonid bivalve *Fronsella ohshimai* Habe (Montacutidae) and the pinnotherid crab *Asthenognathus inaequipes* Stimpson as associates of *Sipunculus nudus*; we describe the pinnotherid here as a new genus and species. Morton and Morton (1983:204) also listed the leptonid bivalve *Nipponomysella subtruncata* (Yokoyama) (Montacutidae) and the pinnotherid crab *Pinnixa rathbuni* Sakai as associates of *Siphonosoma cumanense*; here we correct the identity of the crab to *Mortensenella forceps* Rathbun. This note provides further information on these commensal associations.

Materials and Methods

Sipunculan burrows were identified by their surface apertures, and sometimes digging would expose their deep, fast-burrowing inhabitants. When a sipunculan was obtained, the burrow wall was examined for possible associates. No records were kept in cases where the associate could not be linked positively to the burrow owner. In this way, definite associations have been established. As it was impossible, however, to trace accurately every burrow and collect every associate, the data presented here should be regarded as provisional.

The crab specimens reported below have been deposited in the National Museum of Natural History, Smithsonian Institution, Washington (USNM).

Results

The Pinnotherid Crabs *Indopinnixa*, new genus

Definition.—Carapace much wider than long; integument firm; front narrow, with

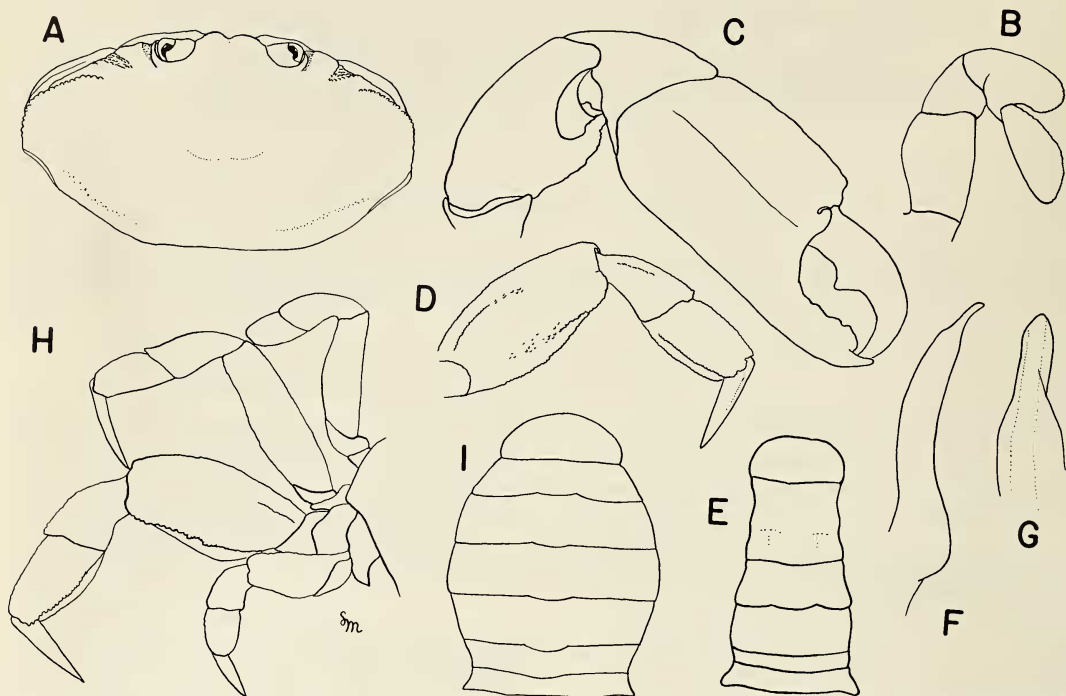


Fig. 1. *Indopinnixa sipunculana*. Male, Hong Kong: A, Carapace; B, Third maxilliped; C, Cheliped; D, Fourth pereopod; E, Abdomen; F, Gonopod; G, Apex of gonopod. Female, Hong Kong: H, Second to fifth pereopods; I, Abdomen.

median groove. Orbit broadly ovate, with wide inner hiatus partly occupied by basal antennal article. Antennules folded into wide fossettes, joined medially under front. Eye-stalks very short. Ischium of third maxilliped short, merus much longer, both slender; palp articulated to summit of merus, distal article arising on inner side of second article. Chelipeds moderately large, hand large, compressed. Third walking leg (P4) stout, largest of all walking legs; first and second walking legs (P2, P3) very slender, fourth and fifth legs (P4, P5) stout. Abdomen of male 6-segmented, fifth and sixth segments fused; seventh segment short, broader than long. Female abdomen 7-segmented. Gonopod simple, tapering distally.

Type species.—*Indopinnixa sipunculana*, new species.

Etymology.—The generic name is derived from the Greek combining form,

“indo-,” and the generic name *Pinnixa*. The gender is feminine.

Remarks.—*Indopinnixa*, which now contains only the type species described below, differs from *Pinnixa* sensu stricto in the form of the male abdomen, which is composed of seven free segments in *Pinnixa*, six segments in *Indopinnixa*, because the fifth and sixth segments are fused.

Indopinnixa sipunculana, new species

Fig. 1

Pinnixa rathbuni.—Morton and Morton, 1983:78, 204. [Not *P. rathbuni* Sakai, 1934.]

Material.—Tai Tam, Hong Kong, Jun 1977, in burrows of *Sipunculus nudus*, leg. B. Morton, 1 male, holotype, USNM 221697.—Same data except date, 20 Jun 1974, 1 ovigerous female, paratype, USNM 222500.

Description.—Carapace 1.83 (male) to 2.15 (female) times broader than long, punctate dorsally, lacking transverse ridge across posterior part. Branchial regions each crossed by low, tuberculate ridge, falling short of orbit. Front bilobed. Anterolateral margin with 2 tomentose depressions visible dorsally, lateral to orbit, depressions connected ventrally, defining smooth, tear-shaped area lateral to orbit. Regions of carapace poorly marked, with transverse median depression, and, on each side, a shallow groove parallel to posterolateral margin.

Chelipeds of male subequal (of female unknown), cheliped with fixed finger in same plane as palm, not deflected ventrally, movable finger (measured dorsally) slightly shorter than palm, latter smooth dorsally, about as long as high, with longitudinal ridge on outer surface. Fingers gaping, movable finger smooth dorsally, curved, tip crossing that of fixed finger, with triangular tooth on opposable margin. First 2 walking legs slender, first short, second about as long as third. Third walking leg largest in both sexes, propodus 1.5 to 1.7 times longer than high, ventral (opposable) margin bicarinate, tomentose; merus 2 times as long as high; dactylus smooth, neither carinate nor tuberculate dorsally. Fourth walking leg stout, extending about to end of merus of third. Walking legs with some plumose setae on dorsal and ventral margins.

Male abdomen of 6 segments, fifth and sixth fused; telson short and broad. Female abdomen of 7 segments, lacking transverse line of hairs on posterior margin of second segment. Male gonopod simple, tapering distally, as figured.

Size.—Carapace length of male 2.3 mm, of ovigerous female 2.0 mm; carapace width of male 4.2 mm, of ovigerous female 4.3 mm. Ova measure 0.3 mm.

Remarks.—Initially we identified this species with *Pinnixa penultipedalis* Stimpson (1858:108; 1907:143), a species originally described from Hong Kong. However,

Stimpson's species was characterized by him as having a smooth and glossy carapace with a distinct transverse ridge posteriorly, a small palm on the cheliped, a very broad merus on the third walking leg (height $\frac{4}{5}$ length), and a line of setae on the posterior margin of the second somite of the abdomen in the female. Our species differs in numerous features: it lacks a distinct ridge posteriorly on the carapace, the surface of the carapace is punctate, not smooth, there is a distinct tuberculate ridge on each branchial region, the palm of the cheliped is large, and the posterior margin of the second abdominal somite in the female is not setose.

Indopinnixa sipunculana also resembles the species identified by Shen (1937:298) with *Pinnixa penultipedalis* Stimpson, especially in the shape of the carapace and the general proportions of the walking legs. Shen's species, which probably is undescribed, differs from *P. penultipedalis* and resembles *I. sipunculana* in lacking a distinct ridge across the posterior part of the carapace. Our species differs from Shen's in having a tuberculate ridge across each branchial region as well as a strong tooth on the cutting edge of the dactylus of the cheliped. Our species further differs in lacking dorsal tubercles on the palm and movable finger of the cheliped and on the upper margin of the dactyls of the walking legs, as well as the line of setae on the posterior margin of the second abdominal segment of the female. Further, the eyes of our species are shorter and the merus of the third walking leg is not nearly so high as in Shen's species.

Indopinnixa sipunculana also is similar to the species from Inhambane, Mozambique, identified by Barnard (1955:19) with *Pinnixa penultipedalis*, to our knowledge the only other record of a pinnotherid crab living with a sipunculan. Barnard's species, which, like Shen's, is probably undescribed, has a sharp ridge across the posterior part of the carapace and lacks the tuberculate branchial ridges as well as the toothed dactylus on the cheliped. Barnard's species fur-

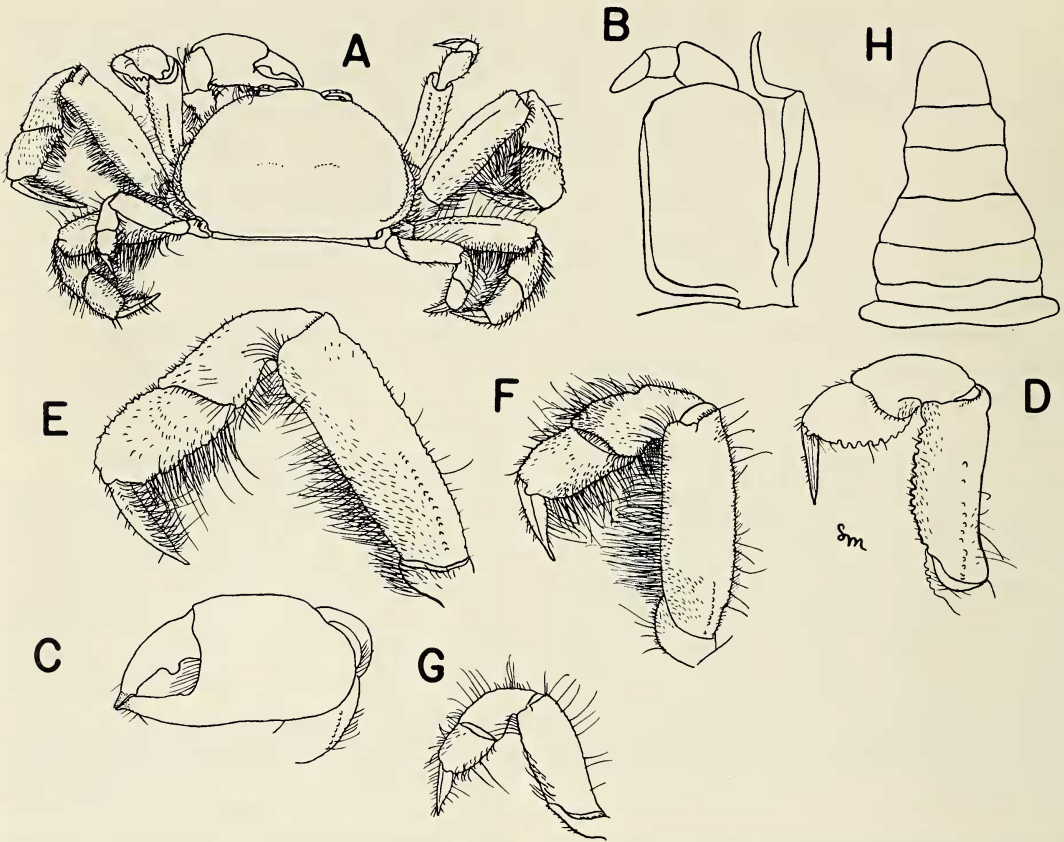


Fig. 2. *Mortensenella forceps* Rathbun, 1909. Male, Hong Kong: A, Dorsal view; B, Third maxilliped; C, Cheliped; D, Second pereopod; E, Third pereopod; F, Fourth pereopod; G, Fifth pereopod; H, Abdomen.

ther differs in having three segments on the male abdomen fused, rather than two as in *I. sipunculana*.

Excluding *Pinnixa brevipes* H. Milne Edwards, 1853, from Madagascar, which may not be a *Pinnixa* (see comments in Serène (1964:277) and Schmitt, McCain, and Davidson (1973:103), for references), and records of the American *Pinnixa faba* (Dana, 1851) from Australia and Tasmania, which may be erroneous (see Rathbun 1918:142), five species of *Pinnixa* are known from the Indo-west Pacific. All five have been reported from Japan and were treated by Sakai (1976:583). Three of the five species, *P. balanoglossana* Sakai, 1934, *P. haematostricta* Sakai, 1934, and *P. penultipedalis*

Stimpson, 1858, have a distinct ridge across the posterior part of the carapace and can be distinguished from *I. sipunculana* on this feature alone.

The other two species, *P. rathbuni* Sakai, 1934, and *P. tumida* Stimpson, 1858, lack distinct branchial ridges, and can be distinguished from *I. sipunculana* on this feature. So far as we can tell, the male abdomens of both of those species are made up of seven free segments; see Yokoya (1928: fig. 6 (*P. rathbuni*) and fig. 7 (*P. tumida*)).

Morton and Morton (1983:78, 204) reported that the entoproct *Loxosomella* occurs on *Indopinnixa sipunculana*.

Etymology.—The specific name alludes to the association of this species with sipunculans worms.

Mortensenella forceps Rathbun, 1909

Fig. 2

Mortensenella forceps Rathbun, 1909:111; 1910:337, fig. 21, pl. 1, fig. 18.—Dai, Feng, Song, and Chen, 1980:137, fig. 9.—Morton and Morton, 1983:177, 204, fig. 9.14. *Asthenognathus inaequipes*.—Morton and Morton, 1983:204. [Not *A. inaequipes* Stimpson, 1858.]

Material.—Tai Tam, Hong Kong; in burrows of *Siphonosoma cumanense*, 19 Dec 1974, leg. B. Morton, 1 male, 1 female, USNM 222501.

Size.—Carapace length of male 5.0 mm, of female 4.6 mm; carapace width of male 8.0 mm, of female 7.5 mm.

Remarks.—These specimens agree well with the accounts of this species given by Rathbun (1909, 1910) and Dai et al. (1980) except that figures given in each of those accounts show the third maxilliped to have an indistinct suture between the ischium and merus; no suture is visible in either of our specimens.

Rathbun's material, from Koh Chang, Thailand, was taken from very shallow water, "outside mangroves." Morton and Morton (1983) recorded this species from Hong Kong as an associate of the echiuroid worm *Ochetostoma erythrogrammon* Leuckart and Rüppel, 1828. The material reported by Dai et al. (1980) was taken off Hainan Island, China; no host was recorded by those authors. These are the only records of this species known to us.

Table 1.—Records of the occurrences of burrow associates of *Sipunculus nudus* and *Siphonosoma cumanense* from Tai Tam Bay, Hong Kong (M = male, F = female, ovig. = ovigerous).

Date	<i>S. nudus</i>		<i>S. cumanense</i>	
	<i>Fronsella ohshimai</i>	<i>Indopinnixa sipunculana</i>	<i>Nipponomysella subtruncata</i>	<i>Mortensenella forceps</i>
20/6/74		1M		
20/6/74		1F ovig.		
20/6/74		1F ovig.		
20/6/74		1F ovig.		
20/6/74			3	
20/6/74			2	
19/12/74	3			
19/12/74				1M, 1F
2/6/77		1M		
2/6/77		1M		
2/6/77	1			
2/6/77		1M		
2/6/77			3	
2/6/77			4	
23/4/79			1	
23/4/79			4	
23/4/79		1M		
26/8/80	9			
26/8/80	7			
26/8/80				1M
26/8/80			7	
21/6/82	8	1F ovig.		
30/1/84	2			
30/1/84			5	
30/1/84			2	
30/1/84			2	
Mean	5	1	3.3	1.5

margins. The brachyuran *Indopinnixa sipunculana* also has been recorded regularly in the burrows, usually as solitary individuals. Ovigerous females of the crab were taken in June of 1974 and 1982. In only one instance (June 1982) were bivalve and crab simultaneously recorded in the same burrow. Mean numbers of bivalves and crabs per host were 5 (range 1–9) and 1, respectively.

Siphonosoma cumanense (Keferstein)

Two associates were recorded with this species: the leptonacean bivalve *Nipponomysella subtruncata* (Yokoyama) and the pinnotherid crab *Mortensenella forceps*

The Sipunculans and Their Associates
Sipunculus nudus Linnaeus

Two associates were found with this species: the leptonacean bivalve *Fronsella ohshimai* Habe, 1958, and an undescribed genus and species of pinotherid crab (Table 1, Fig. 3). The bivalve is an unusual commensal in that it often attaches directly to the host. Up to nine individuals have been recorded attached to a single host by byssal threads, apparently on the posterior valve

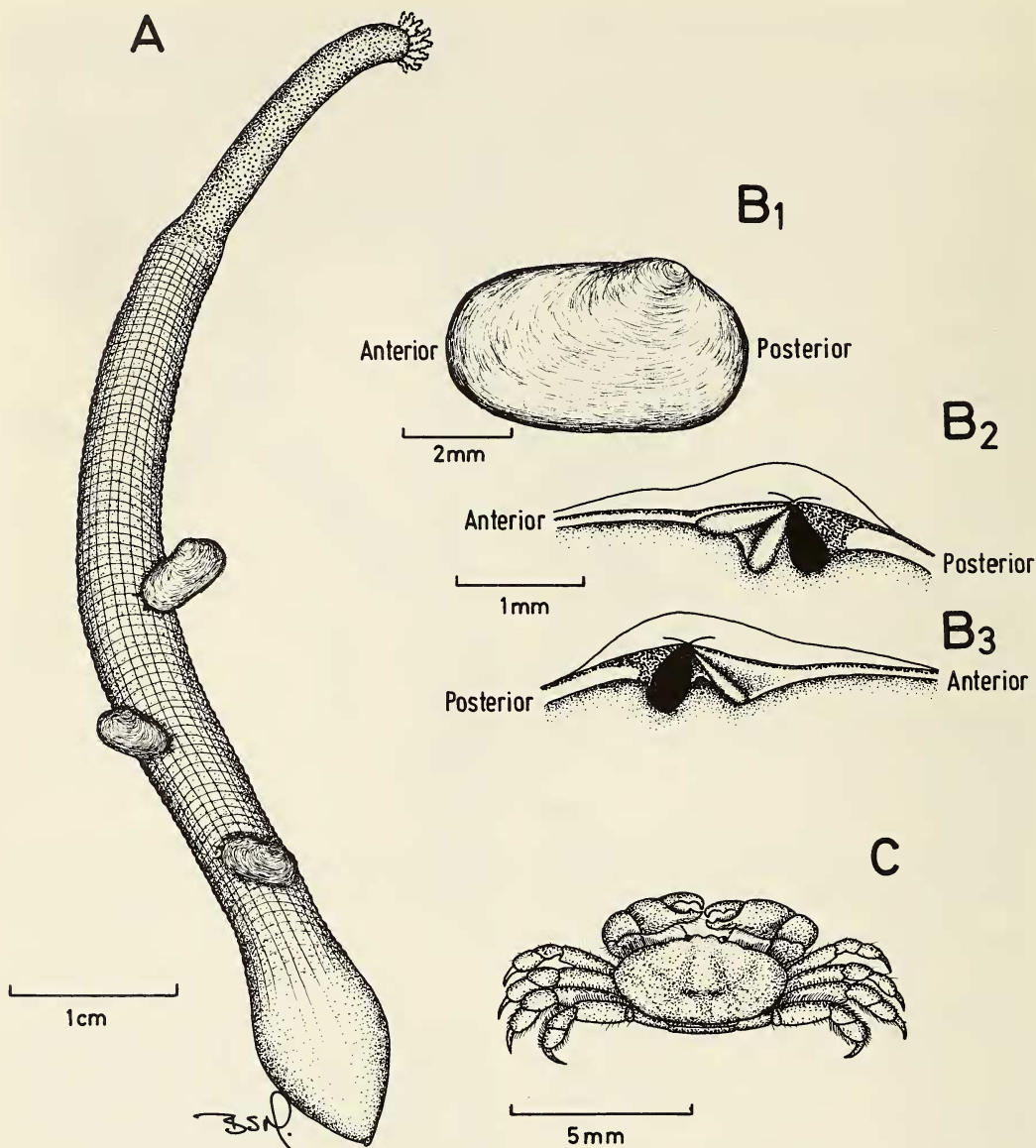


Fig. 3. A, *Sipunculus nudus* with 3 specimens of *Fronsella ohshimai* attached. B, *Fronsella ohshimai*: B1, External view of left shell valve; B2, Interior view of hinge plate of right shell valve; B3, Interior view of hinge plate of left shell valve. C, *Indopinnixa sipunculana*.

Rathbun (Table 1, Fig. 4). The former lies laterally adpressed, but not attached by-sally, against the burrow wall. Up to seven individuals were recorded from a single burrow. The crab *Mortensenella forceps* was recorded from the burrows on two occasions. On 26 August 1980 a single male was collected, and on 19 December 1974 a pair of

crabs was taken. Mean numbers of bivalves and crabs per host were 3.3 (range 1-7) and 1.5, respectively.

Discussion

Sipunculans are well known as hosts of leptonacean bivalves. Boss (1965) and Ste-

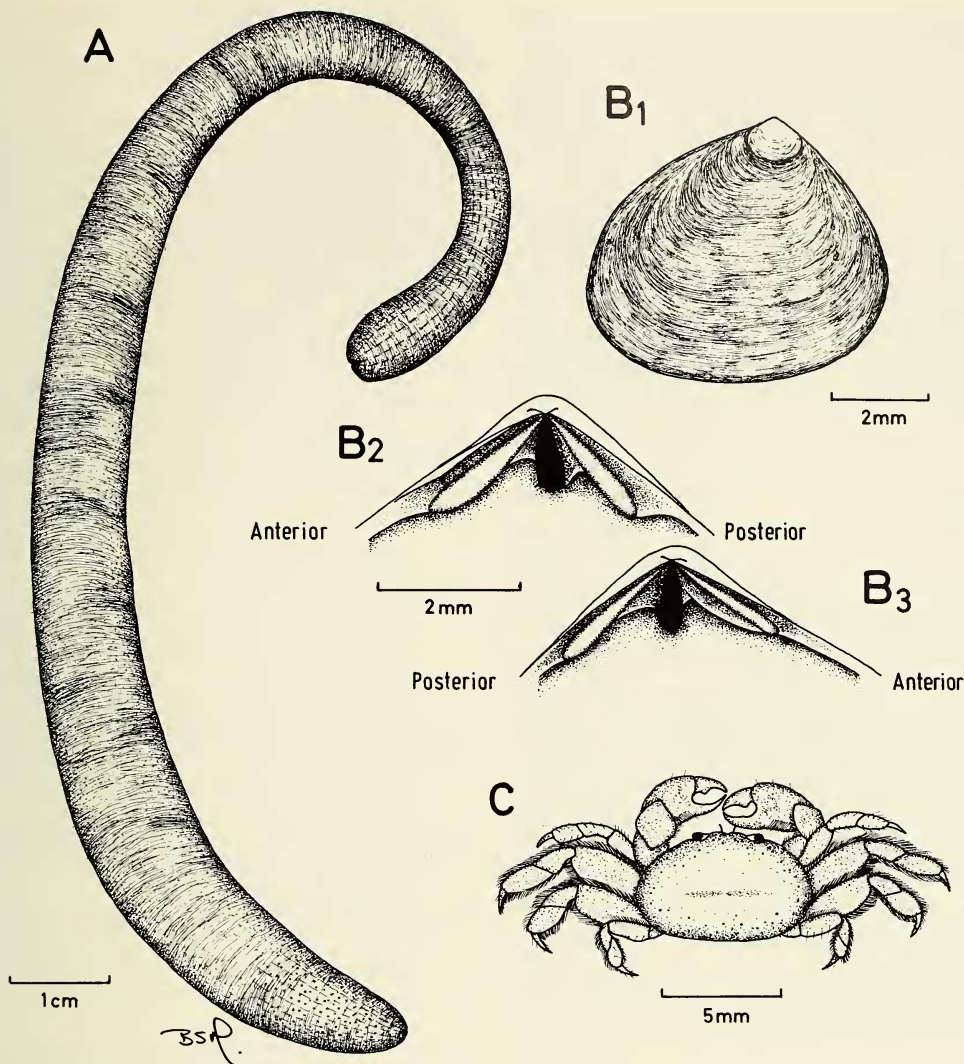


Fig. 4. A, *Siphonosoma cumanense*. B, *Nipponomysella subtruncata*: B1, External view of left shell valve; B2, Interior view of hinge plate of right shell valve; B3, Interior view of hinge plate of left shell valve. C, *Mortensenella forceps*.

phen and Edmonds (1972) have reviewed much of the literature detailing such associations. The most detailed study of such an association, i.e., *Mysella cuneata* (Verrill and Bush) with *Phascolion strombi* (Montagu), is that of Gage (1968). Both of the leptonaceans found with sipunculans in Hong Kong have been recorded from the same hosts elsewhere. *Fronsella ohshimai* is a known associate of *Sipunculus nudus* from

Japan (Habe 1958, 1961, 1964, 1977; Koyama et al. 1981); as in Hong Kong, it attaches to the worm by byssal threads. Similarly, *Nipponomysella subtruncata* is known to be a commensal of *Siphonosoma cumanense* elsewhere, e.g., Utinomi (1972) as *Mysella subtruncata* [sic]. Koyama et al. (1981) reported it, possibly erroneously, to be associated with *Sipunculus nudus*.

In Hong Kong, these two bivalves occur

in groups of, on the average, 5 for *F. ohshimai* and 3.3 for *N. subtruncata*. They almost certainly capitalize on the flow of oxygenated water through the burrow, and, concomitantly, on suspended food particles.

Herein we have corrected identifications by Morton and Morton (1983) of the pinnotherid crabs also inhabiting the burrows of the two sipunculans.

Of interest is that each sipunculan has a pair of associates that are different from, and mutually exclusive of, the other pair. Furthermore, each of the pairs of associates seems mutually exclusive, so that each sipunculan possesses either a bivalve, in varying numbers, or a crab, either singly (more commonly) or as a pair. What determines selective burrow occupation is unknown, but it seems possible that the more active crabs may inhibit establishment of the more sedentary bivalves. There is no other information on this aspect of such relationships, Stephen and Edmonds (1972), for example, not recording crabs as sipunculan associates and giving few examples of multiple commensalism, e.g., the annelid, bivalve and entoproct associates of *Phascolion strombi* (Montagu), but not mutual exclusivity. The Hong Kong sipunculans and their associates may have much to offer in gaining an understanding of these poorly understood taxa and neglected phenomena.

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